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THE RELATIONSHIP OF PUCCINIA AND PHRAGMIDIUM.

By PROF. G. DE LAGERHEIM.

As a distinctive difference between *Puccinia* and *Phragmidium*, Tulasne* asserts that the teleutospores of the first genus are only provided with one germ pore, while those of the second possess several which are equatorially arranged. Since then, however, Dietel† has shown that this is not the case in all *Phragmidiums*, but that in *Ph. obtusum*, Winter, each cell of the teleutospore is provided with only one germ pore situated at the upper end of the cell exactly as in the genus *Puccinia*. *Ph. abidum*, Ludwig, appears to form a transition between the two types.‡ It should also be mentioned that in *Ph. Barnardii*, Plowright & Winter, and in *Ph. carbonarium*, Winter, the end cell is provided with an apical pore. Besides these characteristics, which are, as we see, unreliable, *Phragmidium* is distinguished from *Puccinia* by the number of cells in its teleutospores and by the different structure of its *Æcidia*. But in several *Puccinias* we occasionally find many-celled teleutospores, and therefore this character is not constant. On the contrary the difference in the structure of the *æcidium* appears to be a constant mark of distinction. The *æcidium* of *Puccinia* is provided with a pseudo-peridium, while that of *Phragmidium* is not; and in the latter the spores are cut off from basidia and surrounded only by a row of paraphyses as in the genus *Melampsora*.§

In the above-mentioned work Dietel has attempted to establish the fact that *Phragmidium* is more closely related to *Chrysomyxa* than to *Puccinia*. But in comparing the two genera which he considers to be related he has forgotten to notice the difference existing between their *æcidia* and uredo stages. As has been said, the *æcidium* of *Phragmidium* has no pseudo-peridium, while one is present in the *æcidium* of *Chrysomyxa*. The structure of the uredospores of the two genera differs even more. In *Phragmidium*, as in *Puccinia* and *Uromyces*, they arise singly at the end of a mycelial thread, while on the other hand in *Chrysomyxa*, as in *Coleosporium*, they are borne in rows. I am therefore inclined to believe in a closer relationship between *Puccinia* and *Phragmidium* than between *Chrysomyxa* and *Phragmidium*. This supposed relationship would become still clearer if one could find a *Phragmidium* with a *Puccinia*-*æcidium* or a *Puccinia* with a *Phragmidium*-*æcidium* or with several equatorial germ pores. We can probably regard the genus *Rostrupia*|| as a *Phragmidium* with a *Puccinia*-*æcidium*. The teleutospores

* Ann. de Sci. Nat. Ser. 4, t. II, p. 146.

† Beiträge zur Morphologie und Biologie der Uredineen t. II, 9. Figs. 3-7. (Cassel, 1887.)

‡ Compare Dietel, l. c., t. II, Fig. 10, and Müller Die Rostpilze der Rosa und Rubus-arten und die auf ihnen vorkommenden Parasiten t. I, fig. 9 (Berlin, 1886).

§ The genus *Calyptospora*, Kühn, is not to be united with *Melampsora*, because, as is known, the *Calyptospora*-*æcidia* have a pseudo-peridium.

|| Compare Lagerheim, Sur un nouveau genre d'Urediniées (Journ. d. Botan., 1889), Paris.

of this genus are as a rule 3-4 celled, and the uredospores are formed in the same way as in *Phragmidium* (and *Puccinia*). The æcidia of *Rosstrupia* are unfortunately not known, but judging from its great similarity to certain grass inhabiting *Puccinias* it is very probable that the æcidia are formed as in *Puccinia* and *Uromyces*. A *Puccinia* with a *Phragmidium*-æcidium is not known, although it is not impossible that such a one exists. On the other hand there is one *Puccinia*, or perhaps several, which shows a condition of the germ pores typical for *Phragmidium*.

There are several *Uredineæ* on Barberry species. Besides the well-known æcidium of *Puccinia poculiformis*, Wettstein (*P. graminis*, Persoon), there probably occur three æcidia upon Barberry, namely, *Ae. Magelhaenicum*, Berkeley,* æcidium of *P. berberidis*, Montagne, and an æcidium which appears to belong to a *Diorchidium* frequent around Quito on *Berberis glauca*. The genus *Uromyces* is represented on *Berberis* (*Mahonia*) by one species, *U. sanguineus*. Besides the above mentioned, *P. berberis*, Mont., two *Puccinias*, *P. mirabilissima*, Pk. and *P. antarctica*, Speggazzini, have been observed on Barberry. Finally two uredo forms are found on *Berberis*, namely, *U. æcidiiiformis*, Speggazzini and *U. antarctica*, Speggazzini.

Puccinia mirabilissima was described by Peck in the Botanical Gazette for 1881, p. 226. Tracy and Galloway gave further information concerning it in the Botanical Gazette for 1888, p. 126, and De Toni gives the following diagnosis of the species (Syll. Ured., p. 620).

Maculis late purpureis 3-4 millimeter diameter, leniter incrassatulis, pseudopodiiis hypogenis, longis, pallide flavis, margine grosse laceratis; æcidiosporis subglobosis, 15-20 μ diameter, tuberculatis; maculis parvis, punctiformibus vel majusculis subrotundisque, superne atris vel atrobrunneis; soris hypophyllis, paucis, minutis pallide rufescenti-brunneis; uredosporis subglobosis, obovatis vel piriformibus, obtusis, minutissime rugulosis; 22-33 by 20-23 μ pedicello hyalino, dein deciduo; teleutosporis immixtis, ellipticis, obtusis, ad septum constrictis, subtiliter rugosis, 30-32 by 22-25 μ pedicello longissimo hyalino fultis.

The species is found in several places in the United States on the leaves of *Berberis repens*, and has been distributed in Ellis's North American Fungi, No. 1451, and Rabenhorst-Winter-Pazschke's Fungi Europaei, No. 3619.

In the following I will give the results of my investigations with specimens distributed in Fungi Europaei. They were collected at Thompson Falls, Montana, September, 1884, by Seymour, and in Sierra Nevada, California, May, 1886, by Harkness. Uredo and teleutospores, but no æcidia, were present; the uredospores from the Montana specimens were more or less ovate, those from California piriform.† When treated with warm potash or lactic acid the epispore swelled up so

* *Accidium graveolens*, Shuttleworth, is really identical with *Ae. Magelhaenicum* Berkeley.

† Compare Lagerhiem "L'acide lactique, excellent agent pour l'étude des champignons secs" (Rev. Mycol. No. 42). Toulouse. 1889.

that it could easily be shown to consist of three layers. The outer layer is very thin, colorless, and covered with fine warts; the middle layer is the thickest and is yellowish and smooth; the inner layer appears tolerably firm and is also yellowish and smooth. The uredospore is provided with from three to four equatorial germ pores, and the membrane is not equally thick everywhere, but is not especially thickened at the base of the spore. Treated in the same manner the epispore of the teleutospores showed the same three layers; the warts on the outer layer are somewhat larger and do not stand so close together as on the uredospores. The teleutospores are characterized by a long hyaline pedicel which breaks off at the base and remains in connection with the spore. The pedicel tapers below and is hollow in the lower portion. It is not perfectly smooth everywhere, but a small wart occurs here and there. Probably Peck called this species *mirabilissima* on account of the strikingly long pedicel, but it deserves this epithet in a still higher degree on account of another peculiarity that has been hitherto overlooked. One of the main characters of the genus *Puccinia* is, as we know, that each cell of the teleutospore is provided with but one germ pore which can have different positions, but in *P. mirabilissima* this is not the case, for here is each cell of the teleutospore with two opposite germ pores. These show plainly when the spores are treated as above mentioned. In this respect *P. mirabilissima* varies from all other *Puccinia* that have been carefully observed, and even in this peculiarity I see a point of union between the genera *Puccinia* and *Phragmidium*. It would be of interest to study the germination of this peculiar species, and it is to be hoped that some one of my North American colleagues, to whom living specimens are accessible, will undertake it.

QUITO, ECUADOR.

NOTES.

A NEW PEAR DISEASE.

Something over a year ago we received from one of our correspondents in southern Alabama a number of pear branches affected in a peculiar manner. In a letter sent with the specimens our correspondent described the disease as follows:

The disease appears in the form of spots on the trunk of the tree, always at a dormant bud, also on the branches at the base of another branch or fruitspur. The spots when first noticed were about one-quarter of an inch in diameter, but soon increased to four or five times this size. They are nearly round and are surrounded with whitish uneven edges. When one-half an inch or more in diameter the affected portion becomes depressed and upon cutting into it the bark cambium and a considerable portion of the wood is seen to be brown and dead. In no case has the affection entirely encircled a branch or trunk, but I have no doubt that if allowed to continue it will do so in a short time. I have never seen the disease before and fear it will prove troublesome in my orchard.

Upon examination of the specimens it was found that the disease was due to a fungus known as *Thelephora pedicellata*, Schw. We have this